AN INTRA-COMPANY PRICING SYSTEM IN DECENTRALIZED ORGANIZATIONS

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< CONTENTS >

INTRODUCTION

Description of the Problem

Intra-company pricing is regarded as an essential part of a decentralized

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profit control system in any company where divisions buy from and sell to each other. Along with the spread of the use of decentralization or divisionalization as a means of controlling corporation, the theory and application of pricing for intra-company transfers have been a popular topic in recent accounting literature.

Several questions are to be raised and answered in relation to the subject of intra-company pricing. First, how can one measure the performance of divisions. Second, what are the bases for transferring the products between divisions? Third, what are the theoretical arguments for these methods? Are there any limitations to each method? Fourth, if there are many suggested methods for intra-company pricing, what would be the best method for us to use?

All of these questions are sequentially answered in this thesis. Chapter I analyzes fundamental ideas of profit centers, decentralization, and profit measurement. Chapter II introduces six basic pricing methods for intra-company transfers and presents the arguments and limitations of each method. Also, contemporary thoughts on intra-company pricing will be presented. Chapter III attempts to understand the theoretical basis of intra-company pricing. This chapter will concentrate on the economic theory of intra-company pricing. Chapter IV deals with the application of linear programming to intra-company pricing. I will show how shadow prices as transfer prices are determined by using a linear programming technique. Finally, Chapter V will produce the results of my research on this subject-intra-company pricing. I will provide some reasons why I favor competitive market price and marginal cost as a solution to intra-company pricing.

Apporach

The purposes of this study are (1) to review the literature on the subject of transfer pricing, (2) to identify, analyze, and recommend desirable methods. Several points must be noted for better understanding:

a. The study is primarily a synthesis of ideas, approaches, and procedures which have been advocated in the accounting literature.

b. An attempt is made to develop a theory that will explain some of the important aspects of various transfer pricing methods.

c. This thesis will discuss only the pricing problem between divisions. I will not discuss any subjects such as organizational responsibility for intra-company pricing, elimination of intra-company profits, and legal aspects of intra-company pricing.

d. The study is directed toward simple understanding of a theory in intra-company pricing. No attempt has been made in this thesis to develop a highly complex situation. Thus, economic models as well as the linear programming model are simplified.

e. The cruxes of this thesis are:

(1) Intra-company pricing is a problem of great importance to the decentralized firm.

(2) All of the alternative ways of intra-company pricing are assumed reasonable. Thus, the choice of the method to be used can be made only after the purpose for which the information is to be used is determind.

(3) In my opinion, competitive market price is the best of all methods. If competitive market price is not available, marginal cost will substitute for competitive market price.

(4) Divisional performance should be evaluated on the basis of controllability.

I. BASIC FRAMEWORK OF INTRA-COMPANY PRICING

The basic ideas of intra-company pricing include profit centers, decentralization, and performance measurement of division managers. The purpose of this chapter is to describe and analyze the relationships among these concepts.

1. NATURE OF INTRA-COMPANY PRICING

Definition of Terms

Intra-company pricing is an essential part of a decentralized profit control system in any company where divisions buy from and sell to each other. One of the most comprehensive interpretations has been given by the N.A.C.A. Research Series No. 30 as follows:[1)]

> The term 'interunit transfer' is used to include any movement of products between divisions, plants, or other organizational units of a single company or between separately incorporated companies under common control... The unit value at which goods or services are transferred is called the transfer price.

For the purpose of this thesis, all of the similar terms such as transfer price, intra-company price, inter-unit or inter-company price, and inter-divisional price are considered to have the same meaning.

Conditions

Broadly speaking, transfer pricing may exist when authority is delegated to lower levels of organization. Let me explain it first in simple terms. When transfers of goods or services are made, the product of one division frequently becomes the raw material of another division. In other words, a portion of the revenue of one profit center becomes a portion of the cost

1) National Association of Cost Accountants, *Accounting for Intra-company Transfers*, Research Series No. 30(New York: N.A.C.A., 1956), p. 2.

of another. As a result, the method of pricing may have substantial effect upon divisional profit figures. Thus, the price at which transfers are made can influence the earnings reported by each profit center.

Some cases may exist where there are no transfer prices. First of all, if the company is small enough not to divide the firm into several segments or divisions, there is no need to use transfer prices. Second, if the organization is heavily centralized, there may be no need to set a separate transfer price between organizational subunits. In this situation, prices are determined only at the level of central management. Third, if the division manager is not allowed to have sufficient decision-making authority to control the quality, the quantity, or the mix of product, then a transfer price often should not be used.

Objectives

Intra-company transfer pricing policies are usually designed to implement managerial objectives. Pricing and profit measurement at the division level within a decentralized organization should aim at the following specific objectives. They are classified as main and secondary objectives for convenience.

Main Objectives:

a. To maximize company profit

It is quite clear that the division exists not to earn a profit of its own but to contribute to the profit of the entire business.

b. To provide an adequate profit measurement for appraising the performance of divisional management

Intra-company pricing assists top management in appraising and guiding divisional performance.

c. To make appropriate business decisions

Intra-company pricing provides necessary figures to top management for use in policy decisions.

Secondary Objectives:

a. To foster a sound competitive spirit between divisions
b. To bring the division manager's interests closer to top management's
c. To give division managers both the economic basis and the incentives for correct decisions and to guide divisional management in making decisions to maximize company profit

2. PROFIT CENTERS IN A DECENTRALIZED SYSTEM

Profit Center vs. Service Center

A profit center is a division of a decentralized organization which is responsible for both revenues and expenses. It is conceived as a semi-autonomous group of facilities and functions chosen so that profit performance can be the main guide by which the division manager makes his critical decisions.[2] On the other hand, a service center is a unit organized primarily to perfom a service for or to supply goods to other units in the firm. Essentially, service functions are designed to provide staff activities which cannot be satisfactorily measured in terms of profit. Usually, service functions are centralized and deal with a number of profit centers. Examples of service centers are print shop, document division, legal division, or public relations department.

In an intra-company pricing system, the output from a profit center can be priced in various ways, as will be discussed in Chapter II. The bases for profit centers are cost-based prices, variable or marginal cost, market-based prices, negotiated prices, shadow prices, and arbitrarily-determined prices. Since it is not my intention to develop the pricing for service centers, it is necessary to differentiate between the methods of profit centers and service centers.

Transfer prices of service centers are usually determined at full cost or

2) Joel Dean, "Profit Measruement of Division Managers", *Financial Executive* (*The Controller*), (Sept., 1957), p. 424.

cost plus, or some other arbitrarily-determined price. Cost-based prices are more imprtant than any other bases, as far as service centers are concerned. This is primarily because service centers do not seek to maximize profits. Their function is to perform a service to other divisions in the firm. In other words, the performance of service center managers is judged not on profit but on the basis of how closely its costs adhere to the amount budgeted for the level of activity achieved.

According to an article by Shillinglaw, service center prices should be based on incremental or marginal cost.[3] His reasoning is that what is wanted is a measure of how the activities of individual profit centers affect the cost of central management and other service units. He then argues that only incremental or marginal cost can provide this information.

Characteristics of Profit Center

Dean has suggested the following characteristics to distinguish profit center from service functions.[4] I describe his findings in a briefly summarized form:

a. Operational independence--Each profit center must be an independent operating unit, and its manager must have a large measure of control over most if not all operational decisions that affect his profits.

b. Access to sources and markets--The profit center manager must have control over all decisions relating to sources and markets.

c. Separable costs and revenues--A profit center must be able to split off its costs and find an economically realistic price for the end products.

d. Management intent--Only if the basic goal is profits should the operation be treated as a profit center.

It is frequently assumed that divisions will not always act in the best

3) Gordon Shillinglaw, "Guides to Internal Profit Measurement," *Harvard Business Review*, (Mar./Apr., 1957) p. 83 and p. 93.

4) "Decentralization and Intra-Company Pricing" *Harvard Business Review*, (July/August, 1955), p. 67.

interests of the company. If each division operates so as to maximize its divisional profit, the firm as a whole will not necessarily find its profit maximized. In order that one profit center may not increase its profit by reducing the whole company, transfers must be made if they increase the profit of the company and transfers must not be forced on profit centers if they reduce the profit of the firm.

3. INTRA-COMPANY TRANSFERS FOR PROFIT MEASUREMENT

Transfer Prices, Profit Measurement, and Financial Control

The role of transfer pricing has become more and more important due to the trend toward decentralization, with its multiplicity of internal "profit centers." It is generally understood that problems of measuring division managers' contributions to profits are best solved by dividing the corporation into profit centers. Thus, top management uses divisional income statements in arriving at policy decisions concerning the profitability of decisions. Profit centers may well play a major part in showing a profit or loss for a particular decision.

In developing an internal pricing system, the most important consideration is that internal transfer pricing could support the financial control system by maintaining consistency between company and divisional interests. If decentralized financial control is effective, top management must be able to evaluate the profit performance of the divisional manager so that effective performance can be rewarded.

Measurement of Divisional Performance

To clearly define the measurement of divisional performance several questions must be asked: What is the basis of measuring performance? How do we measure the performance of member of management?

The measurement of performance is not solely based on the maximization of profit. Along with development of behavioral approaches there is a

growing tendency to measure it on various grounds such as public service, growth, meeting or staying ahead of competitors, progress (ideas, productivity or executive development), and human relations, as well as profitability.

Aside from above-mentioned considerations, Harold Bierman has stated that the following quantitative factors can be used as measures of performance:[5] costs and cost variances, physical production (quantity and quality), sales, income, return on investment, investment turnover, income per dollar of sales (operating ratio), share of market, rate of growth, and changes from period to period of any of the above. Therefore, it is not really important that all divisions measure divisional income in the same terms. Moreover, measuring performance of division managers in a big company is difficult, since their activities are numerous and contribute to profits in complex ways. What is important is that performance be appraised in terms that make sense in each divisional case.

Return on Investment vs, Transfer Prices

The method frequently used to accomplish profit performance measurement is to evaluate the divisional manager on the rate of return that he earns on the investment under his control. Horngren has claimed that the major advantage of the rate-of-return technique is its focus on an often neglected phase of management responsibility--the required investment in assets.[6] But, as noted by Shillinglaw, the usefulness of return-on-investment method is more restricted for managerial performance evaluation. The reasons are: first, it violates the criterion of 'attainability,[7] and second, it may not reflect adequately the degree of divisional profit controllability, since the measure of divisional profit should be based on the principle of controlla-

5) *Topics in Cost Accounting and Decisions* (New York: McGraw-Hill Co., 1963), p. 77.

6) Charles T. Horngren, *Cost Accounting: A Managerial Emphasis*, 2nd ed., (Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1967), p. 339.

7) He explained an "attainability" criterion in the following way: "The manager of a division operating in a depressed market, for example, is likely to regard uniform company-wide return-on-investment standards as 'unattainable' and therefore unfair. The manager of a division in an expanding market, on the other hand, can often meet one of these uniform standards with relative ease."

bility.[8] Therefore, Shillinglaw suggests that divisional profit measurement is superior to the return-on-investment method for the measurement of divisional performance.

Profit Concepts

Before we discuss the basis for transfer pricing, it is necessary to clarify the profit concepts used to measure performance of divisional operation. Dean has introduced the idea of three profit concepts: book net profits, real net profits, and contribution profits.[9] He doubts whether any routine divisional net profit computation along traditional full-cost lines can ever mean anything useful to either the divisions or top management. He finally concludes that contribution profits, being confined to costs and revenues over which the profit center manager has control, have fewer drawbacks than any other measures of profits.

Similar analysis has been given by Shillinglaw. Furthermore, Shillinglaw extends his logic clearly and explains the idea in terms of cost accounting. His explanation is best described in Exhibit 1:[10]

Exhibit 1. Four Profit Concepts

Sales		$760,000
Variable cost of goods sold	270,000	
Variable divisional selling and administrative expense	30,000	300,000
* *Sales Margin		460,000
Controllable divisional overhead		200,000
* *Controllable Profit		260,000
Fixed, noncontrollable divisional overhead		150,000
* *Contribution Margin		110,000
Allocation of extradivisional expenses		50,000
* *Net Profit before Taxes		$60,000

8) Shillinglaw, "Problems in Divisional Profit Measurement," *Management Accounting* (*N. A. A. Bulletin*), (March, 1961), p. 37.

9) Dean, "Profit Measurement of Division Managers," pp. 423~426.

10) Shillinglaw, "Guides to Internal Profit Mcasurement," pp. 85~89.

According to Shillinglaw's argument. net profit is the least useful of four concepts for measuring divisional performance. He insists that its usefulness for both evaluation and guidance is destroyed by the arbitrary allocations of extradivisional expenses that must be made in order to derive a net profit figure. He also claims that controllable profit is superior to other three profits in most cases, since it makes up an area in which the division manager can exercise control through customary budgeting procedures.

Dean's controllable profit is considered the same as Shillinglaw's contribution margin. While Dean generally assumes that controllable profits are those which the profit center manager has control of, Shillinglaw has differentiated the meaning beween controllable profit and cottribution profit by considering divisional fixed overhead.

In summary, the allocations of central office costs and fixed divisional overheads be excluded in measuring the performance of a division. The division manager has no control over these costs. Therefore, the measure of divisional profit should be based on the principle of controllability, either eliminating non-controllable charges entirely or making them in such a way as to lead to no variances from profit standards.

II. TRANSFER PRICING METHODS

1. BASES FOR INTRA-COMPANY PRICING

Variously suggested bases for pricing intra-company transfers are distinguished for discussion in this chapter. Each method presents difficulties as well as merits.

It should be recognized before discussion, that no available transfer price technique is likely serve all possible purposes equally well, and that the results of any method employed must be interpreted with a careful consideration of its limitations as a device for profit measurement. Conceptually, all of the alternatives may be reasonable. The choice of the method must

be made after the purpose for which the information is to be used has been determined. Without careful analysis, any intra-company pricing scheme may lead to difficulties and irreparable damages.

Cost-based Prices

The cost methods include actual cost, full cost, full cost plus, and standard cost, all based primarily on the producing division's "historical costs." Generally, cost is defined to include direct material, direct labor, and manufacturing overhead for a manufacturing firm.

Cost-based pricing is known as one of the oldest methods. Strictly speaking, the logic of marginal cost will also start with the cost basis. Actual or full cost with no markup was more common in the past than now. In comparison with other cost methods, full cost plus appears to be gaining wider acceptance because of its merit in profit measurement.

a. Actual Cost or Full Cost

This is the simplest method and is the same as the traditional method of valuation for inventory purposes. Intra-company prices are most widely defined as "cost" to manufacturer. Ordinarily, manufacturing cost is identical to inventoriable cost for transfer purposes, because the principal purpose is to account for internal inventory movements of products.

Actual cost or actual manufacturing cost is similar to full cost, but they are not entirely the same. Actual cost indicates only a purely-incurred manufacturing cost while full cost includes non-inventoried costs such as general and administrative and selling expenses in product cost as well as inventoriable costs.

In the case of full cost, division managers may be responsible for profits on outside sales but manufacturing divisions (i.e., transferors) are not allowed to make a profit on goods transferred to other divisions. Under this circumstance, the transfer of products on the basis of accumulated cost would show no return for the manufacturing division.

b. Full Cost Plus

Frequently, a markup is added to manufacturing cost and non-inventoried costs. The markup added to manufacturing cost may be increased to include a profit in addition to a full share of non-inventoried costs. Most current cost methods make some allowance for profit either as a margin on sales or as a return on investment.

The transfer price using full cost plus will be determined in the following manner:

Exhibit 2. Full Cost Plus

Inventoriable costs	$4.00
General administrative and selling expenses	.30
Full cost to firm	$4.30
Profit added	.20
Total charged to other divisions	$4.50

c. Standard Cost

Where transfers are costed at standard cost, variances from standard cost are usually absorbed currently by the manufacturing division (i.e., transferor division). Most systems of standard costs are based on engineering estimates of transferring the incomplete products from division to division.

Standard cost seems to be superior to actual cost or full cost. If it is an actual cost or full cost, the manufacturing division can bury its inefficiencies in the transfer price. But, with standard cost, inefficiencies show up in the income statement of the manufacturing division division as a result of sales activities.

Variable or Marginal Cost

Conceptually, variable cost is a cost which is uniform per unit but fluctuates, in total, in proportion to sales, production volume, or some other measure of activity. On the other hand, marginal cost is the increase in total costs that results from the production and sale of an additional unit of output. However, these terms mean the same in transfer pricing, based on the assumption that additional cost is caused by the production of an

additional unit of the product.

In economics, the optimum price is determined by the intersection of the transferor division's marginal cost curve and the transferee division's net marginal curve. Net marginal revenue is defined as the transferee division's marginal revenue from the sale of transferred products (finished product after processing) outside the firm less the transferee division's marginal processing cost to transform the transferred products (unfinished) to the final products (finished).[11]

As an illustration, the cost schedule of marginal cost pricing can be presented in Exhibit 3 in order to understand more precisely the operation of the marginal cost as a basis. Exhibit 3 shows how the demands of Divisions B and C and the supply from Division A will be equated at 500 units if the transfer price is set at $210 per 100 units of transferred product (starred). We compare the aggregate quantities of Division A at a corresponding level of marginal cost. Then, at the level where marginal revenue is equal to marginal cost (i.e., $210), the quantities of Division A will be equal to the sum of the quantities of Division B and C (i.e. 500 units = 200 + 300).

Just as full cost basis is broken down into full cost and full cost plus, marginal cost can be divided into pure marginal cost and marginal cost plus a fixed fee. In the case of marginal cost plus, the selling division manager is given some sort of fixed fee. This fixed fee may cover only the fixed costs involved, or it may include some element of profit as well.

Exhibit 3. Marginal Cost Basis

Division A (Transferor Division)

Units	Unit price	TC	MC
100	$9.00	$900	.....
200	5.00	1000	$100
300	3.83	1150	150

11) More detailed definitions of marginal cost, marginal revenue, and net marginal revenue can be found in Section 1 of Chapter III.

400	3.35	1340	190
*500	3.10	1550	*210
600	2.91	1750	200

Division B (Transferee Division)

Units	Unit price minus processing cost	TNR	NMR
100	$6.20	$620	.....
*200	4.15	830	*$210
300	3.36	1010	180
400	2.93	1175	165
500	2.67	1327	152
600	2.44	1469	142

Division C (Transferee Division)

Units	Unit price minus processing cost	TNR	NMR
100	$6.30	$630	.....
200	4.40	880	$250
*300	3.30	1090	*210
400	3.17	1270	180
500	2.85	1425	155
600	2.60	1565	140

Where

TC : transferor division's total cost

MC : transferor division's marginal cost

TNR: transferee division's total net revenue

NMR: transferee division's net marginal revenue

Market-based Prices

Under the market-based prices, pricing of intra-company transfers is guided by the values the goods could have in a competitive market. In other words, each selling division should charge and each buying division should pay, a price which the product could command if sold to, or bought from, outside customers or suppliers. Therefore, transfer prices can be established to measure the income that would accrue to the selling unit.

Generally, the existence of market prices for divisional products will provide a basis for transfer prices which allows complete decentralization. This is primarily because competitive market pricing attempts to place each division in the same position that it would occuppy if it were an independent business in the market.

By the same token, competitive market price is probably the method which is most often used in practice. The use of market price simulates the marketconditions which the divisions would face if the divisions were separate corporate entities.

a. Fair Market Value or Published Market Price

We can use market quotations for determining the price in transactions. We can also use the results of economic and engineering research to estimate what a free market price would be. In implementing a market-price transfer pricing system, we must always keep in mind the fair market value of the products.

However, published data on market price is criticized on the grounds that it is too fragmentary and unreliable to determine transfer prices. Rather, it should be used as a guide only.

In the absence of published market price, profit centers may be given authority to test and use the outside market. They can buy and sell inside or outside the firm depending on where the greatest profit is.

b. Sales Minus

In this instance, transfer prices are geared to final selling prices by subtracting allowance that more or less completely provide for the costs and profits of intervening operations. For example, it is determind by transfers of gasoline from the refinery at the retail price minus an allowance for the marketing department's services in getting it from the refinery to the customer.[12] In this way, the marketing department will take the burden of allowances in its profit and loss accounts. Dean also evaluated this base in the following manner:

> This system has the virtue of being oriented toward the market value of the final product. However, it shifts the full impact of fluctuations in final price to the basic production units of an integrated firm, with the intermediate processing and marketing operations sheltered by an assured margin.[13]

12) Dean, "Decentralization and Intracompany Pricing",
13) *Ibid.*, p. 70.

The only advantage of this method over market price is that it will tend to increase the probability of inside purchase, but with its use, the divisional statements will not be nearly so helpful.

c. List Price or Sales-based Price

Here, the company's own selling price for similar items may be used as a market price. As a modification of market price, a list price could be established for each item, based on cost, standard cost or competitive market price for the article. One of the serious drawbacks of this base is that a transferee division will always show just a normal profit. Therefore, it is assumed that there is not much incentive for profit maximization in that division.

Negotiated Price

In the absence of market-based prices, transfer prices for products are quite frequently decided by negotiation between the transferee divisions. To develop the negotiated transfer price, there should be a meeting of the two or more operating divisions--buying and selling ones. Sometimes, this meeting is held with the aid of top management.

This method can also be varied. Dean proposed the idea of "competitive negotiated price" which is a combination of market price and negotiated price.[14] However, Dean is believed to be one of the strong advocates of the negotiated price.

Shadow Price

Recent advances in the techique of linear programming have increased the relevance of shadow price to the transfer pricing problem. The application of linear programming to the transfer pricing problem is based upon the relationship between the primal and dual solutions in the linear programming.

In terms of linear programming, optimal shadow price may be computed

14) *Ibid.*, pp. 65-74.

with the simplex model by solving the dual.[15] Shadow prices are conceived of as "the economic value oropportunity cost of the scarce resource". I will further discuss this problem in the linear programming section of Chapter III. I will also show how shadow prices are determined mathematically.

Arbitrary Pricing

In addition to the above-mentioned methods, there is the arbitrarily-determined pricing method which has been used quite often in the past. In this instance, the price usually set arbitrarily by central executives is considered best for overall company interests with neither the transferor nor transferee divisions having any control over the financial decision.

2. CONTEMPORARY THOUGHT

This section examines the accounting literature on the subject of various transfer pricing methods. There are numerous arguments for using a particular transfer pricing method, because transfer pricing methods are so diversified.

Cost-based Prices

a. Full Cost or Full Cost Plus

Greer contends that use of a cost or cost plus method on transferred output may best serve to remove the influence of inter-division production from profit calculations of a producing unit, though a market or market-related price must necessarilly be employed for by-products which cannot be independently costed.[16] However, he also suggests a dual pricing to make up for shortcomings of a cost basis.

b. Standard Cost

15) Besides this application, shadow prices are interpreted in terms of corner solution in a graphic form and in terms of the cash balance of working capital. To understand these usages, it may be helpful to read William Beranek's *Working Capital Management* (Belmont, Calif.: Wadsworth Publishing Co., Inc., 1966), pp. 102-115.

16) Howard Greer, "Divisional Profit Calculation--Notes on the Transfer Problem", *Management Accounting* (*N.A.A. Bulletin*), (July, 1962), p. 11

Stone is a strong proponent of standard cost system in intra-company pricing. He argues that the use of standard cost overcomes most of the difficulties if the standards are good standards. The standard price can be a goal for the producing department (transferor) and a fair price to the purchasing deparment (transferee).[17] Also, he admits that the problem is the usual difficulty accompanying the establishment and operation of any standard cost system.

Variable or Marginal Cost

McMurray believes that out-of-pocket costs make the best transfer price.[18] In addition to this, both Solomons and Hirshleifer favor the use of marginal cost in absence of market price or if the market is imperfectly competitive.[19] Hirshleifer made the point as follows:

> The argument made in the present paper is that market price is the correct transfer price only where the commodity being transferred is produced in a competitive market... If the market is imperfectly competitive, or where no market for the transferred commodity exist, the correct procedure is to transfer at marginal cost or at some price between marginal cost and market price in the most general case.[20]

Market-based Prices

Anthony argues that the ideal transfer price is based on a well established market price for the identical product or service being transferred.[21] Menge also preferred this method in that the ultimate objective of an internal transfer pricing system should be to obtain realistic market prices upon which valid choices relating to the sources of supply can be based.[22] Arr-

17) Williard E. Stone, "Intracompany-Pricing", *Accounting Review*, (Jan., 1960), p. 11.

18) Robert McMurray, "Where Out-of-pocket Costs Make the Best Transfer Price", *Management Accounting* (N.A.A. Bulletin), (August, 1961), p. 34.

19) David Solomons, *Divisional Performance: Measurement and Control*, (Homewood, III.: Richard D. Irwin, Inc., 1965), pp. 171-187.

20) Jack Hirshleifer, "On the Economics of Transfer Pricing", *Journal of Business*, (July, 1956), p. 172.

21) Anthony, "Notes on Transfer Prices"; Robert Anthony, John Dearden, and Richard Vancil, eds., *Management Control Systems: Cases and Readings*, (Homewood, Ill.: Richard D. Irwin, Inc., 1965), p. 259.

22) John A. Menge, "The Backward Art of Interdivisional Transfer Pricing", *Journal of Industrial Economics*, (July, 1961), pp. 231~232.

ow agrees that the transfer price should be the market price and the divisions should be free to trade inside or outside the firm.[23]

Negotiated Price

In the July/August, 1955 issue of *Harvard Busness Review*, Dean proposed the delicate idea of "Competive negotiated price".[24] He also describes the necessary condition for profit center control as the freedom of division managers to negotiate competitive prices in arm's length bargaining and to go outside the company, if the prices paid by or to other division managers are not agreeable to them.

Shadow Prices

Proponents of this method are so called management scientists such as Beranek, Baumol, and Fabian. They develop shadow prices as part of linear programming in order to solve the problem of proper allocation of resources.

Dual Pricing

All dual pricing faces the problem of what to do with the difference between the transferor and transferee divisions.

First, Drebin submitted a proposal for dual pricing. In essence, his proposal depends on two separate sets of transfer prices: marginal cost for the buying division (transferee); and final selling price, less cost to complete and fair return to subsequent divisions, for the selling division (transferor). He has stated:

> The buying division schould be charged marginal cost, while the selling division should be credited for selling price minus profits and cost to complete. In this way, the selling division will continue to expand output as long as its marginal costs are less than its marginal revenues (which because of the transfer price are also the firm's marginal revenues). This would be the same level of production arrived at by one trying to optimize the profits of the whole firm.[25]

23) K.J. Arrow, "Optimization, Decentralization, and Internal Pricing in Business Firms", *Contributions to Scien tific Management*, pp. 9~18.

24) Dean, "Decentralization and Intracompany Pricing," pp. 65~74.

25) Allan R. Drebin "A Proposal for Dual Pricing of Intra-company Transfers", *Management Accounting* (*N.A.A. Bulletin*), (Feb., 1959), p. 54.

As Drebin mentioned, there would be a strong objection against two sets of price for the same transaction because of the difficulty in accounting which the system causes. Therefore, though this porposal is worthwhile to study for theoretical research, it is difficult to apply. It should be noted that Drebin also agrees that the methods should arrive at a single price for intra-company transfers.

Second, Greer proposed the use of dual pricing in addition to cost basis. His arguments are summed up as follows:

> Assessing all previously accumulated "other-division" costs to a receiving unit on transferred input may so penalize (or inflate) its results as to give a false impression of its real profit contribution and potentialities. A partial solution, in some instances, might be found in a combination procedure, under which (a) the producing unit is credited with cost (plus) or market, whichever is higher, and (b) the receiving unit is charged with cot (plus) or market, whichever is lower. The difference is then identifiable as the cost to the company of compelling two divisions to do business with each other, instead of utilizing independent outlets or sources.26)

Third, Lewis stated two other methods of dual pricing.[27] Firstly, transfers can be priced at cost, but a percentage or proportion of the profit subsequently earned is given back to the transfer pricing division. Secondly, selling divisions can transfer at selling price, while the buying division charged cost.

3. EVALUATION

The choice of a pricing system depends both on the kinds of information that are available and in the objectives that the management hopes to accomplish through the system. It is quite difficult to say with any great confidence how useful one particular method could be. Whether or not a system works basically depends on circumstances.

Most articles have been devoted to the use of market-based transfer pri-

26) Greer, *op. cit.*, p. 11.

27) Ronello B. Lewis, *Financial Analysis for Management* (Englewood Cliffs, N. J.: Prentice-Hall, Inc., 1957), pp. 146～147.

ces. Their basic reasoning is that the intra-company transfer pricing should permit each unit of a company to earn a profit commensurate with the functions it performs. The authors of those articles believe that earnings attributable to individual responsibilities are best measured by this method. I presonally support the market-based price, if available, not only because it is readily adaptable to decentralized firms but because it can be understood reasonably by both the selling and the buying divisions. Anyway, the concept of market price is not as simple as it might seem. Serious limitations have been noted in this section of market-based prices.

I evaluated various methods by identifying their advantages as well as their limitations.

Cost-based Prices

Advantages

a. The primary advantage is simplicity.

Despite the obvious limitations of the approach, transfer prices based on cost are in common use. The main reason for their wide use is that they are understandable and convenient. They avoid the elimination of intra-company profits from inventories in consolidated financial statements and tax returns.

b. The transferred "cost" can readily be used to measure production efficiency by comparing actual with budgeted costs. This is because the method allows simple and adequate end-product costing for profit analysis by product lines.

c. As Bierman stated, the general financial accounting reports require that inventories be recorded at cost to conform to generally accepted accounting principles.[28] This cost must be full cost, including manufacturing overhead but not including any element of unrealized profit(i.e., profit not realized by sale to a party outside the corporate organization).

Limitations

28) Harold Bierman, "Pricing Intracompany Transfers", *Accounting Review*, (July, 1959), p.432.

a. The cost-based price may not be suited to companies with a decentralized structure which need to measure the profitability of autonomous units.

b. As Greer observed, "cost basis lacks not only any utility in the field of evaluation and motivation, but also the objectivity required of a good performance standard which a market-based price possesses."[29] He argues this on the grounds that each primary and intermediate processing department is "guaranteed" the reçovery of its cost (or cost plus profit) on each product transferred to another department.

c. As Shillinglaw stressed, "the major defect of full cost as a basis for transfer pricing is that it fails to provide a sound guide to incremental decision-making". He explained it in this way:

> The manager of a division which received intermediate products from other divisions treats the transfer price as a variable cost of his own operation··· He will not buy, unless the price that he can receive for the sale of the final product is enough to cover the transfer price plus any additional processing and marketing costs that he might incur. The overall effect of the transactionmight be to increase total company profit, but the full cost transfer price will obscure this fact.

Variable or Marginal Cost

Advantages

a. The marginal cost approach has been suggested as the best transfer pricing system to be used when decisions have to be made.[31] For decision making purposes, the differential costs of the goods transferred from division to division should be known. The marginal cost is used to make the following four general types of decisions.

1) Make-or-buy decisions
2) The pricing of end-products
3) Output decisions of components and end products
4) Capital budgeting decisions and decisions to drop products

29) Greer, *op. cit.*, p. 11.
30) Shillinglaw, *Cost Accounting Analysis and Control*, (Homewood, Ill.: Richard D. Irwin, Inc., 1961), p. 732.
31) Bierman, "Pricing Intracompany Transfers", p. 431.

b. Marginal costing is particularly adaptable to firms already using direct costing in their accounting systems.

c. Marginal cost, like all of the other cost techniques, can be used in those instances where the market prices of the intermediate goods are not available.

Limitations

a. As Horngren observed, "the motivational impact of using marginal costs is a thorny problem, since the use of marginal costs hardly permits the use of profit centers as ordinary conceived". [32]

b. As Bierman observed, the use of marginal cost may result in weird actions, such as attempting to decrease efficiency, or aiming to have an increasing marginal cost curve in order to increase divisional profits (by increasing marginal costs and thus increasing the price of the product). [33]

Market-based Prices

Advantages

a. It is generally believed that market-based prices are best suited to decentralized firms. Under this method every operating division will be able to show profits. Thus this method can show divisional performance precisely.

b. A market provides an incentive to efficient production because it reflects product profitability at various stages of production.

c. It provides reliable measures of divisional income because these prices are established independently rather than by individuals who have an interest in the results.

d. It places unit operations on a competitive basis.

e. It permits division managers freedom of action. It charges the same price for its own customers and company customers.

Limitations

a. It requires the existence of a well developed outside competitive mar-

32) Horngren, *op. cit.*, p. 349.

33) Biearmn, *Topics in Cost Accounting and Decisions*, p. 101.

ket. Unfortunately, a market price is not always determinable for transferred products.

b. It adds an element of profit or less with each transfer of product and therewith complicates the accounting procedures.

c. Determining market prices will be difficult and complicated in some instances. There are case where discounts are allowed for particular types of trade or the terms relating to delivery payment, service, and warranty may constitute part of the deal.

d. There are also products not traded in any outside market and for which no market quotations are available for guiding intracompany pricing.

Negotiated Prices

Advantages

a. It can be used in the absence of a competitive outside market.

b. The setting of the price by negotiation between buying and selling divisions allows the division managers the greatest degree of authority and control over the profit of their divisions.

c. It can establish a more realistic price than is likely to be arrived at by reference to a cost-plus formula or a published market price.

Limitations

a. There may be occasions where thousands of commodities or parts must be priced. The task would be long and arduous for the bargaining representatives.

b. To be successful, this method requires frequent reexamination and revision of prices.

c. Frequently, negotiation can become time-consuming.

d. Often it may distort division financial report by arbitrary allocation so that top management may be misled in its attempt to evaluate performance and market decisions.

e. It often leads to divisional rivalries and bitterness.

Shadow Prices

Advantages

a. Shadow prices can be easily acquired by those firms who are presently operating with linear programming on their own computer.

b. The linear programming technique can be used to solve the problem of capacity constraints which often complicate the intra-company pricing problem considerably. Linear programming provides a production program in terms of capacity constraints which will make the best use of the limited capacity in the transferor division.

Limitations

a. This method is subject to the same limitations that the other methods of variable or marginal cost were.

b. One of the most important weaknesses of shadow prices is that they can not be computed alone. There must be additional information about marginal costs in the computation of shadow prices as transfer prices, since we would have to add the variable costs of the materials in addition prices.

Arbitrary Pricing

Limitation

a. It defeats the most important purpose of decentralizing profit responsibility namely making divisional personnel profit conscious. It also severely hampers the profit incentive of division managers.

Ⅲ. ECONOMIC THEORY OF PRICING

1. GENERAL

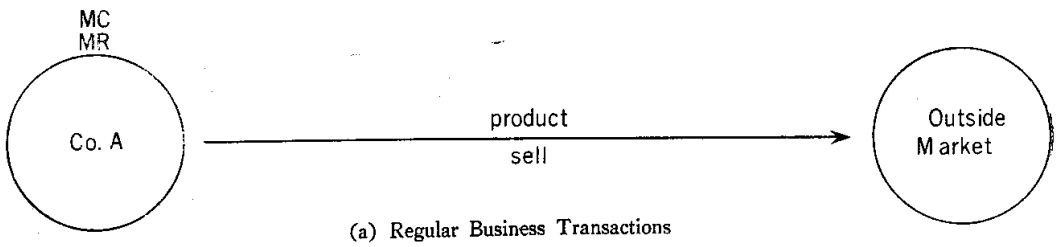
The problem of intra-company pricing between division of a vertically or horizontally decentralized firm is generally similar to the classical problem of economics. In economic terms, economists usually follow the price mechanism in which the best profit is determined at the point where marginal

revenue and marginal cost are equal. Much of the theoretical analysis which follows originates from the works of Solomons, Hirshleifer, Morris, and Gould.[34]

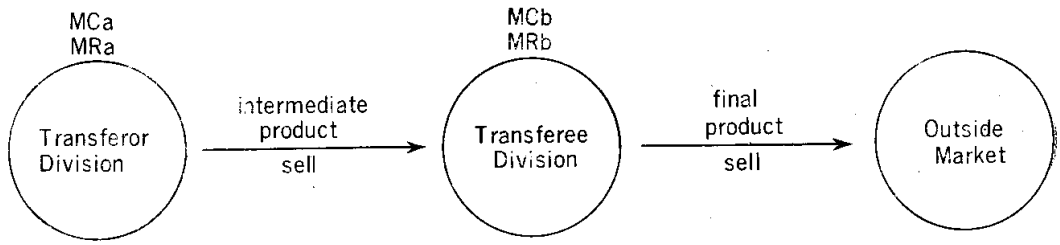
It should be noted, before discussion, that one of the most important arguments of the above-mentioned economists is that they generally favor market-based prices in a perfect market and marginal cost in imperfect markets (i.e., monopolistic competition, oligopoly, and monopoly). Considering that there are many suggested bases for transfer pricing, as we have studied in the previous chapter, their arguments are very interesting. So far, there have been few objections to these theoretical works. Though some writers did not attempt to relate the problem of transfer pricing to the principles of economics, it would be worthwile to develop their arguments to find the correct transfer price for various situations.

Definition of Terms

Exhibit 4. Comparison of Transactions between Separate Businesses and between Profit Centers



(a) Regular Business Transactions



(b) Transactions where the product is transferred and subsequently sold to the outside market

34) Solomons, *op.* cit., pp. 160-232.
Hirshleifer, *op. cit.*, pp. 71-78.
William Morris, *Decentralization in Management Systems*, (Columbus, Ohio: Ohio State University Press, 1968), pp. 176-195.
J.R. Gould, "The Pricing of Transactions between Members of a Group of Companies", *Accountancy*, (June, 1960), pp. 61-67.

Before I discuss the economics of intra-company pricing in full, I will explain the symbols which will be used in this chapter.

Exhibit 4 depicts the typical relationship between two business organizations (independent companies or two divisions) and an outside market. In Exhibit 4 (a), without transfer pricing, the maximum profit is determined at the level at which Co. A's marginal cost equals Co. A's marginal revenue.

In Exhibit 4 (b), a typical transfer pricing transaction is presented. Consider, for simplicity, that a firm comprises two divisions: a transferor division that produces the intermediate product, and a transferee division that transforms the intermediate product and sells the final product outside the firm. A transferor division may have marginal cost for production (MCa) and marginal reveue (MRa) from transferring the intermediate product to a transferee division. Similarly, a transferee division may have marginal processing cost (MCp) to transform the intermediate product to the final product and marginal revenue (MRb) from marketing the final product outside the firm.[35]

We call the commodity exchanged between the transferor and transferee divisions the *intermediate product*. *Final product* is the commodity exchanged between the transferee division and the outside market.

2. TRANSFER PRICES IN ECONOMICS

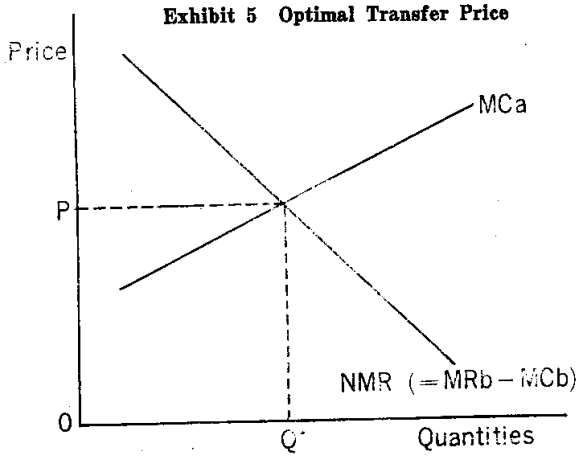
Optimal Transfer Price

Exhibit 5 shows the simplest form of price mechanism of transfer pricing. Transfer price is determined at the intersection between the marginal cost curve of transferor division and the net marginal revenue curve of transferee division. In this situation, P is the transfer price which would

35) Morris, *op. cit.*, pp. 176-196.
Solomons, *op. cit.*, pp. 212-228.
Gould, *op. cit.*, pp. 62-64.
Hirshleifer, *op. cit.*, pp. 174-180.

lead autonomous profit-maximizing divisions to this solution.

Exhibit 5 Optimal Transfer Price



In this diagram MCa curve is shown as rising from left to right as production expands. NMR is the net marginal revenue curve of transferee division. NMR also represents the price of the final product minus the marginal cost of processing the intermediate product (i.e., MRb-MCb). This line falls from left to right, because an increasing marginal cost (MCb) of processing is being deduucted from a constant selling price per unit of the final product (MRb).

Transfer Prices in a Perfect Market

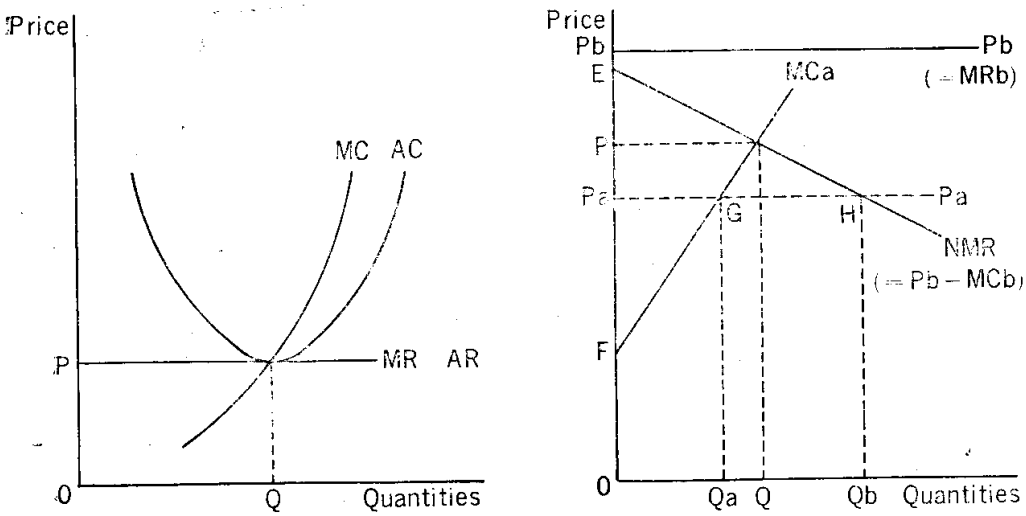
Here, we assume that each division is free to determine its own output. We also assume that the intermediate market between transferor and transferee divisions as well as the final market between transferee division and outstide market is competitive. In other words, those three organizations exist competitively, not related interdependently.

If there really is a competitive market for the transferred products, a transferee division can satisfy its needs for transferred products by buying them outside. On the other hand, if the transfer price is set at its market price, the transferor division can supply as much as it wishes.

Exhibit 6 displays the familiar model of pure competition. Under pure competition, a company will maximize its profit by increasing output up

to the point at which MC equals price. This is also the point at which average cost is the lowest. In the diagram, the perfectly competitive firm producing at the maximum profit point where MC equals MR is also producing where MC equals price.

Exhibit 6. Perfect Market



(a) Price and output under perfect competition

(b) Transfer prices in a perfect market where Pa is a competitive market price[36]

In Exhibit 6(b), the optimal transfer price is determined at the intersection between marginal cost curve and marginal revenue curve. But, assuming that there is a competitive market price, the situation becomes more complex. Exhibit 6(b) shows the position where a transferee division using an intermediate product is supplied both by transfers from transferor division and by purchases in a competitive market from outside suppliers.

It is assumed, under perfect competition, that the horizontal line Pb represents not only the demand curve for the final product of transferee division, but also the marginal revenue curve of the transferee division. Since the selling price of final product and marginal revenue are constant in a perfect market, the Pb line is assumed to be horizontal.

A transferor division will supply only OQa units at a competitive mar-

36) Solomons, *op.cit.*, p. 213.

ket price Pa, for selling more than this will add to its revenue (as shown by the line MCa). Thus the transferee division will get OQa of its supply of the intermediate from a transferor division and the distance QaQb by purchase on the market. Simultaneously, area EPaH denotes the transferee division's profit and area FPaG denotes the transferor division's profit.

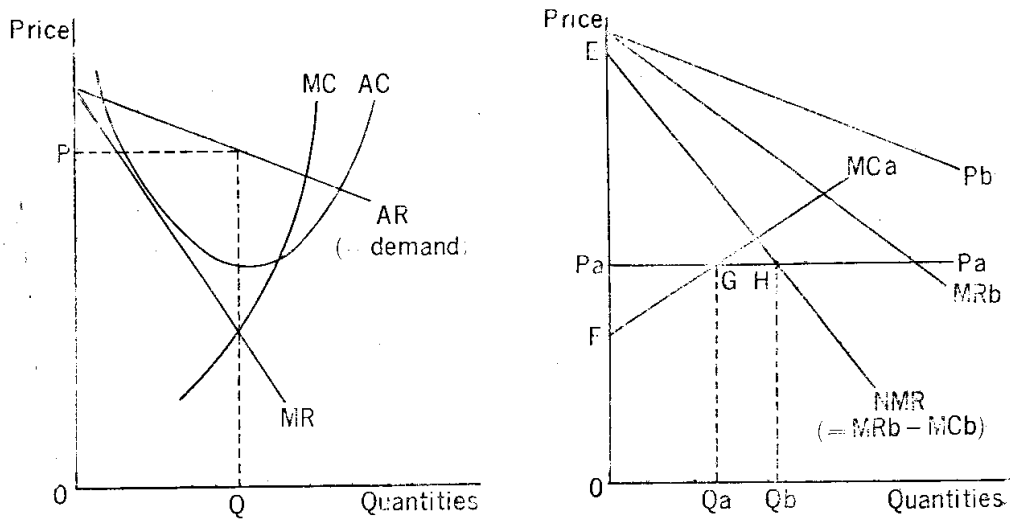
Transfer Prices in Imperfect Markets

We now turn to the substantially more difficult case where the market for the final product is imperfectly competitive.

In Exhibit 7(a) we have the typical imperfect competitor's downward-sloping demand curve. Following the rule that profits will be maximized by equating marginal cost and marginal revenue, the firm will produce at the output level at which price is greater than marginal cost.

In Exhibit 7(b), differing from the competitive market case, we have to show the price line (Pb) as falling from left to right since the transferee division can only achieve an increase in volume by accepting a lower price.

Exhibit 7. Imperfect Market



(a) Price and output under imperfect competition (b) Transfer prices in imperfect markets[37]

37) *Ibid.*, p. 216.

Transfer prices in an imperfect market are determined the same way as in a perfect market. In an imperfect market, the transferor division will be willing to supply only the quantity OQa at the current market price Pa, for quantities in excess of OQa add more to its cost than to its revenues. On the other hand, the transferee division is willing to acquire a quantity OQb of the intermediate at the present market price Pa. Thus a transferee division may acquire quantity OQa of the intermediate at the price Pa from transferor division and an additional quantity QaQb by purchase from outside.

3. MARGINAL COST AS AN IDEAL TRANSFER PRICE

As noted in this chapter, many economists have suggested that the proper solution to intra-company pricing is to set transfer prices equal to the trans feror division's marginal cost. To select the ideal transfer price, economists have attempted to use traditional economic principle in that the rule marginal cost=marginal revenue leads to the maximization of profits to the firm as a whole. The soundness of the economic theory of intra-company pricing has been proved algebraically (see *Variable or marginal Cost*) and graphically as shown in this chapter.

Morris has extended his analysis to reinforce the conceptual soundness of the marginal cost rule. The following interpretations have appeared in his book.[38] I summarize his explanation in short. For convenience, I have slightly modified the names of symbols so that they can be stated in consistent with the symbols used in this chapter. The following symbols denote:

P : transfer price
D : units transferred
PR(D) : profits to the firm
TCa(D) : transferor division's total production cost using D units

38) Morris, *op.cit.*, pp. 178~184.

TCb(D) : transferee division's total intermediate processing cost using D units

TRb(D) : transferee division's total revenue from the sale of final products

MCa(D) : transferor division's marginal cost of processing

MCb(D) : transferee division's marginal cost

MRb(D) : transferee division's marginal revenue

Using these symbols the profit of the firm will be determined by

$$PR(D) = TRb(D) - TCb(D) - TCa(D)$$

Then profit will be maximized when

$$\frac{PR(D)}{dD} = O = MRb(D) - MCb(D) - MCa(D)$$

The transferor division computes its divisional profit as $(P \times D) - TCa(D)$ and maximizes it by choosing D so as to make $MCa(D) = P$. On the other hand, transferee division pays a price P to the transferor division for the materials transferred between the two. The transferee division will choose D so as to make $MRb(D) = MCb(D) + P$. This formula is exactly the same as $P = MRb(D) - MCb(D)$. In this case, $MRb(C) - MCb(D)$ is the net marginal revenue of the transferee division.

Thus if the transfer price P is chosen equal to the transferor's marginal cost and the transferee's net marginal revenue,

$$\text{i.e.,} P = MCa(D) = MRb(D) - MCb(D),$$

both divisions will adopt the same level of operation, and this level will be optimal for the firm. Morris also claimed that the selection of the appropriate transfer price using marginal cost solves the problem of coordination among decentralized units, yet produces results equal to those under centralized operation.[39]

39) *Ibid.*, p. 180.

IV. APPLICATION OF LINEAR PROGRAMMING

1. SIMPLEX METHOD

It is generally accepted that linear programming offers a technique for allocation scarce resources among different choices of output. As a result, we select the "best" or "optimum" answers. Mathematically, linear programming is a method of optimizing an objective linear function subject to number of constaints stated in terms of linear inequalities.

One of the most important contributions of linear programming to transfer pricing would be the computation of shadow prices. The application of linear programming to transfer pricing is based upon the relationship betweenthe primal and dual solutions. Generally, there may be three steps to arrive at the shadow price as transfer price.

Steps:

1. Solve the primal problem by using simplex method or product-mix technique or graphical method.
2. Solve the dual problem with the information which we get in the first step. Here, we arrive at the shadow price.
3. Add the shadow price on the variable cost to arrive at the desired transfer price.

It would not be appropriate here to devote space to a general description and discussion of linear programming. What is of particular interest to me in the present context is how to arrive at shadow price and subsequent transfer price under this technique.

First Step: Primal Solution

There are three ways to get the final answer for the primal problem: simplex method, product-mix technique, and graphical method. all three methods give us the same result. To solve the primal problem, the problem must be framed in terms of linear equations by adding slack variables to

convert inequalities to equalities. Next, we locate a feasible solutions as are necessary to get the final answer. This continuous procedure is presented in the Appendix of this chapter.

To illustrate, I use the same data which has been stated in Solomons' book.[40] Solomons has computed this problem with a product-mix technique; however, I reached the same answer as he did, using the alternative method. The detailed solution will be presented in the Appendix.

Problem and Information:

(1) We assume that Division A (transferor) makes the intermediate products B_1 and B_2 using materials S, T, and V and transfers these to Division B (transferee). Then, Division B converts intermediate products into the final products and sells to the outside market.

(2) The required quantities (per unit of B_1 and B_2) of the materials produced by Division A (which are known as S, T, and V) and A's maximum productive capacity per week are shown in Exhibit 8.

Exhibit 8. Required Quantities and Maximum Capacity

	Meterials		
	S	T	V
Quantities used per unit of product			
B_1	2 lbs.	$\frac{1}{2}$	1
B_2	2	2	3
Maximum productive capacity per week in Division A	4000 lbs.	3000	4800

(3) The variable costs of producing S, T, and V (per pound) are $1.00, $0.50, $0.75,

(4) Division B's costs of processing B_1 and B_2 and converting them into the final products are $2.00 per unit of B_1 and $1.75 per unit of B_2.

(5) There is no outside source of supply for S, T, and V.

(6) Division B sells two products B_1 and B_2 for $8 and $14 on outside market.

40) Solmons, *op. cit.*, pp. 229~232.

Extension of the Information:

(1) Using the Information which was presented we can set up Exhibit 9 to decide what quantity of products B_1 and B_2 to manufacture in order to maximize the total contribution made by the products.

Exhibit 9. Cost Schedule and Profit

	Products			
	B_1		B_2	
Selling price per unit		8.00		14.00
Variable costs Division A--materials				
S	2.00		2.00	
T	0.25		1.00	
V	0.75		2.25	
	3.00		5.25	
Division B--processing	2.00		1.75	
Total variable costs		5.00		7.00
Contribution per unit		3.00		7.00

Now, we can formulate the profit function as follows:

$$P=3B_1+7B_2$$

★ Computation of variable costs for each material used:

e.g., B_1, S $2\times1=2.00$

T $1/2\times0.5=0.25$

V $1\times0.75=0.75$

B_2, S $2\times1=2.00$

T $2\times0.5=1.00$

V $3\times0.75=2.25$

The other figures are given in the problem

(2) We can also formulate the following inequality equations using the above information.

Maximize profit, P, when $P=3B_1+7B_2$

subject to

the S capacity constraint: $2B_1+2B_2\leq4000$

the T capacity constraint: $1/2B_1+2B_2\leq3000$

the V capacity constraint: $B_1+3B_2\leq4800$

We add the condition that negative product quantities are ruled out, i.e.,

$$B_2 \geq 0$$

$$B_2 \geq 0$$

Required

Compute the amounts of P, B_1, B_2, Ks, Kt, and Kv. And what is the profit function if the values of Ks, Kt, and Kv are unknown?

Answer:

(See Appendix for detailed solution)

The profit function (i.e., objective equation) which we wanted is

$P = \$11333 - 5/6Ks - 8/3Kt$

where P = profit

Ks = slack variable which makes up for the S capacity constraint

Kt = slack variable which makes up for the T capacity constraint

Inspection of this objective equation shows that we have reached an optimal solution for the First Step, for apart from the profit of \$11333 it contains nothing but negative terms, so that giving Ks and Kt values in exess of zero would only reduce the profit.[41]

Second Step: Dual Solution

The dual solution can be read straight off the objective function simply by taking the coefficients of slack variables.[42] The profit function $P = \$11333 - 5/6Ks - 8/3Kt$ indicates that a pound of S is worth \$0.83 (i.e., 5/6), a pound of T is worth \$2.67 (i.e., 8/3), and a pound of V is worth \$0.00. These three figures (\$0.83, \$2.67, and \$0.00) are called shadow prices.

Shadow prices for the materials S, T, and V represent their contribution to the final profit produced by B_1 and B_2. In Exhibit 8, materials used per unit of product are 2, 1/2, 1 lbs. for S, T, and V to make B_1, and 2, 2, 3 lbs. for S, T, and V to make B_2. Now, we can prove that the shadow

41) Values of B_1, B_2, Ks, Kt, and Kv are presented in Appendix.

42) Solmons, *op. cit.*, p. 232

prices of the materials exactly exhaust the profit contributions of products:[43]

B_1 is worth $(2 \times \$0.83) + (1/2 \times \$2.67) + (1 \times \$0.00) = \$3.00$

B_2 is worth $(2 \times 0.83) + (2 \times 2.67) + (3 \times 0.00) = 7.00$

Therefore, the shadow prices show the amount by which total profits would be increased if the division making the materials (transferor division) could increase its productive capacity of each of them by one pound.

Third Step: Transfer Price

The shadow prices which have been computed could not be used directly as taransfer prices. To turn shadow prices into transfer price, we would have to add the variable costs of the materials--the information which was given in the problem. The dual solution tells us that a pound of S is worth \$0.83 over and above its variable cost; and a pound of T is worth \$2.67 more than its variable cost; and V is worth nothing more than its variable cost. The reason why shadow prices are to be added to the variable cost is not explicit in Solomons's *Divisional Performance: Measurement and Control.* Instead he states that:

> *These transfer prices (which are the sum of shadow price and variable cost) would be the counterparts, in a situation where productive capacities are restricted, to the incremental costs which we saw to be the theoretically "right" transfer prices where production of the transfered products could be expanded without restriction by simply paying the incremental cost.*[45]

Solomons's book implies that since shadow prices show only the capacity constraint on production, we have to add variable costs to these shadow prices. Furthermore, he states that, in case of V (i.e., where the transfer price shown for V is the same as its variable cost per pound), V is in effect unlimited in capacity or supply.

Exhibit 10. Transfer Prices

	S	T	V
Variable cost per pound	\$1.00	0.50	0.75

43) *Ibid.*, p. 191.
44) *Ibid.*
45) *IIbid.*

Shadow price per pound	$0.83	2.67	---
	$1.83	3.17	0.75

In Exhibit 10, we may arrive at the desired transfer prices. Here, it should be noted that shadow price is not same as transfer price. We have to take another step to arrive at the final transfer price. Therefore, shadow prices can be defined as the optimal values of the dual variables, since they reflect the imputed values of the scarce resources implied in the primal problem.

2. DECOMPOSITION METHOD

In recent years new developments in non-linear programming have taken place. One of these developments, the decomposition principle, offers advantages to the transfer price problem when the problem involves non-linear functions. This computational technique has been developed by Dantzig and Wolfe. It uses the technique to deal with a linear programming problem containing thousands of constraints and variables.

Unfortunately, non-linear solution technique is rather complex so a discussion of the implications will not be undertaken here. According to Baumol and Fabian, the practical use of non-linear program as a basis for transfer price is not immediately at hand since efficient methods for solving large systems of non-linear programming are still being developed.[46]

3. APPENDIX TO CHAPTER III

COMPUTATION OF THE PRIMAL PROBLEM USING THE SIMPLEX METHOD[47]

Solution: Four Steps

(1) Using the information which was presented in pp. 50-53 of this

46) Nicholas Dopuch, and DaAid Drake, "Accounting Implications of a Mathematical Programming Approach to the Transfer Price Problem", *Journal of Accounting Research* (April, 1964), p. 19.

47) Solutiont o the problem follows the technique which has been presented in William Beranek's *Analysis for Financial Decisions* (Homewood, III: Richard D.Irwin, Inc., 1963), pp. 407-431.

chapter, we can convert inequality equations into equality equations. The constraint inequalities are first converted into equations by introducing "slack variables" representing unused capacity, if any, in Division A's operations. We shall call these Ks, Kt, and Kv to represent idle capacity in the production of S, T, and V.

$P=3B_1+7B_2$

$2B_1+2B_2+Ks=4000$

$1/2B_1+2B_2+Kt=3000$

$B_1+3B_2+Kv=4800$

(2) Set up the Tableau 0 (Original Tableau)

We first formulate the original tableau to find out the feasible solution. Before we solve the problem we have to understand some special terms which will be used in this Appendix. They are pivot variable, pivot column, pivot row, opportunity cost, and incremental profit. The definition of these terms will be presented with the tableux.

Pivot variable, pivot column, and pivot row are the variable, column, and row which will make the largest contribution to profits. These will minimize computational effort in the simplex method. In Exhibit 11, we can find the pivot variable, pivot column, and pivot row. The pivot variable is determined in the following steps: first, find the largest number of incremental profit (Cj-Zj) to get the pivot column; second, divide column b by each of the pivot column numbers to arrive at the check figures; third, find the smallest number of check figures; fourth, select the pivot variable where the pivot row meets the pivot column. By doing so, we get the pivot variable=2, pivot row=fourth row (see arrow), pivot column=fourth colum (see arrow).[48]

The profit which is sacrificed by virtue of bringing into a solution one unit of a given variable is an "opportunity cost". It is usually denoted by

48) This computational method has been introduced inDr. W.D. Knight's class of *Business* 736: *Financial Management* at the Univeraity of Wisconsin in Madison.

the symbol Zj. Zj can be calculated by adding the products of each of the first column (column Cj) and each of the third colum (column B_1), the

Exhibit 11. Tableau 0

Cj		3	7	0	0	0		
	Basis	B_1	B_2	Ks	Kt	Kv	b	Check
0	Ks	2	2	1	0	0	4000	2000
0	Kt	½	*2	0	1	0	3000	1500 ←
0	Kv	1	3	0	0	1	4800	1600
	Zj	0	0	0	0	0	0	
	Cj-Zj	3	7	0	0	0		
			↑					

Where Cj: coefficient in the profit function

Zj: opportunity cost which is the amount of profit to be sacrificed

Cj-Zj: incremental profit or net contribution

fourth(colum B_2), the fifth (column Ks), the sixth (column Kt), the seventh(column Kv), and the eighth (colum b).[49]

Thus we can calculate Zj in Exhibit 11 as follows:

e.g., B_1, $(0\times 2)+(0\times 1/2)+(0\times 1)=0$

B_2, $(0\times 2)+(0\times 2)+(0\times 3)=0$

Ks, $(0\times 1)+(0\times 0)+(0\times 0)=0$

b, $(0\times 4000)+(0\times 3000)+(0\times 4800)=0$

(3) Formulate the Tableau 1

Since there are no negative figures in the row Cj-Zj of Tableau, 0, we move to the next feasible solution. Negative numbers in the row Cj-Zj indicate that net contribution or incremental profit (i.e., Cj-Zj) will go down to below zero. Therefore, we have to make more computational efforts until negative numbers or zeroes appear in the row $C_j - Z_j$

In Exhibit 12, we substitute B_2 for Kt in the second column. The variable Kt is removed from the basis and in our next solution it is set equal to zero. Then B_2 substitutes for K_2 for the fourth row (row B_2 in Tableau 1). The row which contained the variable Kt was said to be the pivot row in Tableau O.

49) Beranek, *Analysis for Financial Decisions*, pp. 411—412.

Exhibit12. Tableau 1

C_j	Basis	3 B_1	7 B_2	0 Ks	0 Kt	0 Kv	b	Check
0	Ks	*3/2	0	1	−1	0	1000	2000/3 ←
7	B_2	1/4	1	0	1/2	0	1500	6000
0	Kv	1/4	0	0	−3/2	1	300	1200
	Z_j	7/4	7	0	7/2	0	10500	
	C_j-Z_j	5/4	0	0	−7/2	0		

↑

Next, we transform all other coefficients in the column of B_1 to zero except the row B_1 in Tableau 2. This can be done as follows.[50] We multiply the pivot variable of the original tableau by some unknown, say, y. We may get B_2 coefficient of $2y+2$ in Tableau O. Then, we find a value for y such that $2y+2=0$.[51] Hence $y=-1$. Therefore, multiplying the pivot row by -1 and adding this result to the third row (i.e., row Ks)of the Tableau 0 will yield the third row (i.e., row Ks) of our new Taleau 1.

e.g., column B_1, $(-1x1/2)+2=3/2$

B_2, $(-1x2)+2=0$

b, $(-1x3000)+4000=1000$

(4) The next solution

All of the computations of the Tableau 2 are similarly made as we have done in the previous steps. Fortunately, we can find that there are no

Exhibit 13. Tableau 2

C_j	Basis	3 B_1	7 B_2	0 Ks	0 Kt	0 Kv	b	Check
3	B1	1	0	2/3	-2/3	0	*2000/3	−1000
7	B2	0	1	-1/6	2/3	0	*4000/3	2000
0	Kv	0	0	-1/6	-4/3	0	* 400/3	−80
	Z_j	3	7	5/6	8/3	0	*34000/3	
	C_j-Z_j	0	0	*-5/6	*-8/3	*0		

50) *Ibid.*, p.415.

51) Beranek that the object of this step is to tranform all other coefficients in the column vector of B1 to zero in the Tableau 2 except the row B1. This procedure will make an identity matrix betw een the columns B1 and the rows B1 and B2 (see Exhibit13).

positive numbers in the row $C_j - Z_j$. Thus we have solved the problem.

Finally, we can derive the desired answer from the Tableau 2 as follows:

$P = 34000/3 \fallingdotseq \$11333$ (since Ks and Kt are zero)

$B_1 = 2000/3 \fallingdotseq 666$ units

$B_2 = 4000/3 \fallingdotseq 1333$ units

$Ks = 0$

$Kt = 0$

$Kv = 400/3 \fallingdotseq 133$ lbs.

Also, we can read the required objection function in the Tableau 2 as $P = \$11333 - 5/6Ks - 8/3Kt$. An inspection of the column b reflects that the optimal criterion is satisfied by the solution $B_1 = 2000/3$, $B_2 = 4000/3$ and $Kv = 400/3$.

V. SELECTION

1. GENERALIZATION

The manner in which transferred goods are priced has an important influence on the profits of both the transferor and transferee divisions. So far, I have analyzed six different methods for transfer pricing. In analyzing the relationship between various basis, the major problem is that there is no single method that is appropriate for all purposes. In practice, the solution to a pricing problem can be a research job which may require the cooperation and coordination of the market specialist, industrial engineer, economist, statistician, and cost accountants. Without research, it seems to be hard to choose the best method.

Despite this, I will continue my efforts to find the best methods, although they will not satisfy all occasions. Some thought on various methods can be made in the following statement:

Cost basis: possible candidate if the company is heavily centralized. Since we are looking for the method which is adaptable to the decen-

tralized firm, we have to *abandon* this method.

Marginal cost: possible candidate. One of the strong arguments for this method is that it is useful for decision-making. In addition, theoretically, this method is sound.

Market-based Prices: possible candidate if the market prices are readily obtained. Since this method encourages divisional competition, it is an ideal for decentralized firms.

Negotiated Prices: possible candidate if pricing is determined by reasonable terms.

Shadow Prices: possible candidate if the linear programming technique can be readily developed in a business. But this method requires more complex computation in addition to marginal cost pricing.

Arbitrary Pricing: not to be considered here. Accountants are always making efforts to avoid the arbitrary decisions in business.

2. TESTS FOR SELECTION

Some of the guidelines for selecting the best method of intracompany pricing are presented below.

a. Profitability test

The intra-company pricing scheme should be designed to facilitate the maximization of corporate profits rather than divisional profits. Thus the best method for intracompany pricing must provide the maximum profit for the company as a whole. Divisions should not be allowed to make profits by reducing profits of the overall company.

b. Performance measurement test

An intra-company pricing system should provide an adequate performance yardstick for the measurement of divisional management.

c. Decision-making test

An intra-company pricing system should provide figures to top management of divisions and a central office for use in policy decisions.

d. Decentralization test

An intra-company pricing system should maintain and not violate the principles of decentralization such as delegation of authority and granting divisional autonomy. Also, it should establish a price that fosters a healthy interdivisional competitive spirit.

e. Availability and Simplicity test

Transfer prices should be easily found and be as simple as possible to use in business.

3. FINAL SELECTION

The folowing explanations are made to support my arguments for competitive market price if it is available and marginal cost as a substitution for competitive market price if competitive market price does not exist.

Competitive Market Price

As noted in *Market-based Prices*(chapterII) of this thesis, there are three kinds of market-based prices: fair market value or published market price, sales minus, and list price. I refer to competitive market price either as fair market value or published market price. The sales method or list price will not be included in the category of a competitive market price, since they weaken the effectivenss of divisional income-statement as a performance measurement technique. Competitive market price will be evaluated on the basis of tests for selection.

a. Profitability Test

Under this method every operating division should be able to show profits. Division mangers will show the maximum profit when their particular division does well. But a question is raised as to whether the competitive market price is fair or not. If it is not fair, competitive market price would not assure us the maximum profit.

b. Performance Measurement Test

The competitive market price enables top management to evaluate the

performance of divisional managers. Measuring profit-center performance on a competitive basis motivates each profit center to do what is in its own best profit interest. At the same time, division managers will encourage those working under them to work harder when the results reported by divisional statements are not really good so that their division can improve its performance for future reports.

c. Decision-making Test

Market prices generally satisfy the decision-making needs of the division managers. Market-based prices place unit operations on a competitive basis, and permit division managers freedom of action.

d. Decentralization Test

Market-based prices are the basis for attaining managerial decentralization. Eash division can enjoy managerial and financial automy in a market price transfer pricing.

e. Availability and Simplicity Test

Again, one of the most vexing problems for the market-based prices is that a well-developed outside market might not exist. In general, a market price transfer system may be regarded as workable whenever the transferred product is one which is traded actively and in substantial quantity at prices that approximate those available in published quotations.

Market price can be one of the simplest methods. It does not involve the separation of variable and fixed costs which might be a very difficult task under cost methods.

In summary, the competitive market price system will satisfy the tests b, c, d, and the simplicity test. If the market price is fair, it will also satisfy the profitability test. Thus the only weakness of competitive market price will be its availability. If its availability is assured on the market, the competitive market price will be free of any shortcomings that the other methods have.

Marginal Cost

If a good competitive market for the transferred product is lacking, then another basis of transfer pricing has to be found. I feel that marginal cost has almost as many merits as the competitive market price.

a. Profitability Test

The marginal or variable cost is geared to the economists' idea that the optimal level for any firm is where the marginal cost is equal to the marginal revenue. In this way, the firm will maximize profit.

b. Performance Measurement Test

This method may cause some problems in how to evaluatet he division managers. Motivation may be quite low as the transferror division will show only marginal cost and not usually show profit. In marginal costing, profit is realized through the transferee division's net marginal revenue. With this motivational factor, division managers may not place as much emphasis on improvement as might be necessary.

c. Decision-making Test

The marginal or variable cost approach has been suggested as the best transfer pricing system to be used when decisions have to be made. Bierman enumerated four kinds of decision-making that may be made using this method: (a) make-or-buy, (b) pricing of end product, (c) level of output, (d) capital budgeting decisions and decisions to drop products.[52]

For example, within a division, "make-or-buy" decisions, if made rationally, call for a comparison of the cost of buying outside with the incremental cost of producing the product inside. The use of incremental cost as the basis of transfer pricing will enable the make-or-buy decision to be made just as it would be in a non-divisionalized firm.

d. Decentralization Test

This method seems incompatible with the operation of decentralized profit center. Managerial decisions are usually made at one point, in this case by

52) Bierman, "Pricing Intra-company Transfers", p. 431.

the transferor division's manager. The essence of decentralization is that decision-making authority is diffused, not concentrated at one point in the organization.

e. Availability and Simplicity Test

Availability will not be any problem for marginal cost pricing. The information of marginal cost can be obtained through the transferror's manufacturing process. Also, the transferee's net marginal revenue can be available.

But the question arises as to whether marginal cost pricing is simple or not. A negative answer may be justified here because of its complex procedure in calculation.

In spite of its various limitations (performance measurement, decentralization, and simplicicity test), marginal cost pricing is my second choice in case there is no competitive market price. In comparison with other methods such as negotiated prices, arbitrarily-determined price, and cost basis marginal costing has more merits, as noted in the Evaluation Section of Chapter II.

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